

What is Claimed:

- 1 1. A wireless communications transceiver system comprising:
- 2 an antenna for receiving an incoming radio frequency input signal
- 3 having a radio frequency carrier modulated by an incoming audio signal
- 4 component;
- 5 a low noise amplifier for amplifying the radio frequency input
- 6 signal;
- 7 a first radio frequency variable gain mixer having:
- 8 (a) means for supplying a first local oscillator signal,
- 9 (b) a first input section circuit responsive to the amplified radio
- 10 frequency input signal for translating the amplified radio
- 11 frequency input signal from a voltage signal to first and
- 12 second constant current signals, and
- 13 (c) a first mixer core circuit responsive to the first and second
- 14 constant current signals and the first local oscillator signal for
- 15 developing a differential mixed intermediate frequency input
- 16 signal;
- 17 a first intermediate frequency variable gain mixer having:
- 18 (a) means for supplying a second local oscillator signal,
- 19 (b) a second input section circuit responsive to the differential
- 20 mixed intermediate frequency input signal for translating the
- 21 differential mixed intermediate frequency input signal from a
- 22 voltage signal to third and fourth constant current signals, and

23 (c) a mixer core circuit responsive to the third and fourth
24 constant current signals and the second local oscillator signal
25 for developing a differential mixed low frequency input
26 signal;

27 a demodulator for detecting the incoming audio signal component
28 from the differential mixed low frequency input signal;

29 a first audio amplifier for amplifying the incoming audio signal
30 component;

31 a speaker for converting the amplified incoming audio signal
32 component to incoming audio;

33 a microphone for converting outgoing audio to an outgoing audio
34 signal component;

35 a second audio amplifier for amplifying the outgoing audio signal
36 component;

37 a modulator for developing an outgoing low frequency output signal
38 having a low frequency carrier modulated by the outgoing audio signal
39 component;

40 a second intermediate frequency variable gain mixer having:

41 (a) means for supplying a third local oscillator signal,

42 (b) a third input section circuit responsive to the low frequency
43 output signal for translating the low frequency output signal
44 from a voltage signal to fifth and sixth constant current
45 signals, and

46 (c) a third mixer core circuit responsive to the fifth and sixth
 47 constant current signals and the third local oscillator signal
 48 for developing a differential mixed intermediate frequency
 49 output signal;

50 a second radio frequency variable gain mixer having:

51 (a) means for supplying a fourth local oscillator signal,
 52 (b) a fourth input section circuit responsive to the intermediate
 53 frequency output signal for translating the intermediate
 54 frequency output signal from a voltage signal to seventh and
 55 eighth constant current signals, and

56 (c) a fourth mixer core circuit responsive to the seventh and
 57 eighth constant current signals and the fourth local oscillator
 58 signal for developing a differential mixed radio frequency
 59 output signal;

60 a driver amplifier for amplifying the radio frequency output signal;

61 and

62 an antenna for transmitting the amplified radio frequency output
 63 signal.

1 2. A wireless communications transceiver system according to
 2 claim 1 further comprising:

3 (a) a first variable gain amplifier between said first radio
 4 frequency variable gain mixer and said first intermediate
 5 frequency variable gain mixer,

- 6 (b) a second variable gain amplifier between said first
7 intermediate frequency variable gain mixer and said
8 demodulator,
- 9 (c) a third variable gain amplifier between said modulator and
10 said second intermediate frequency variable gain mixer, and
- 11 (d) a fourth variable gain amplifier between said second
12 intermediate frequency variable gain mixer and said second
13 radio frequency variable gain mixer.

1 3. A wireless communications transceiver system according to
2 claim 1 wherein each of said input section circuits of said variable gain mixers
3 includes:

- 4 (a) a plurality of pairs of transducers with each pair of
5 transducers connected in a differential configuration and:
- 6 (1) the outputs of a first of each pair of said transducers
7 connected together for supplying one of the constant
8 current signals,
- 9 (2) the outputs of a second of each pair of said transducers
10 connected together for supplying the other of the
11 constant current signals,
- 12 (3) the inputs of a first of each pair of said transducers
13 connected together for receiving the input signal, and
- 14 (4) the inputs of a second of each pair of said transducers
15 connected together for receiving the input signal,

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16 (b) a plurality of impedances each connected between a first of
17 each pair of said transducers and a second of each pair of said
18 transducers,

19 (c) a plurality of pairs of constant current sources, a first of each
20 pair of said constant current sources connected in series with
21 a first of each pair of said transducers and a second of each
22 pair of said constant current sources connected in series with
23 a second of each pair of said transducers, and

24 (d) means for selectively activating a pair of said constant current
25 sources to produce:

26 (1) the first constant current signal at said output of said
27 transducer connected in series with said activated first
28 constant current source, and

29 (2) the second constant current signal at said output of said
30 transducer connected in series with said activated
31 second constant current source.

1 4. A wireless communications transceiver system according to
2 claim 2 wherein each of said input section circuits of said variable gain mixers
3 further includes:

4 (a) a plurality of pairs of transducers with each pair of
5 transducers connected in a differential configuration and:

6 (1) the outputs of a first of each pair of said transducers
7 connected together for supplying one of the constant
8 current signals,

- 9 (2) the outputs of a second of each pair of said transducers
10 connected together for supplying the other of the
11 constant current signals,
- 12 (3) the inputs of a first of each pair of said transducers
13 connected together for receiving the input signal, and
- 14 (4) the inputs of a second of each pair of said transducers
15 connected together for receiving the input signal,
- 16 (b) a plurality of impedances each connected between a first of
17 each pair of said transducers and a second of each pair of said
18 transducers,
- 19 (c) a plurality of pairs of constant current sources, a first of each
20 pair of said constant current sources connected in series with
21 a first of each pair of said transducers and a second of each
22 pair of said constant current sources connected in series with
23 a second of each pair of said transducers, and
- 24 (d) means for selectively activating a pair of said constant current
25 sources to produce:
- 26 (1) the first constant current signal at said output of said
27 transducer connected in series with said activated first
28 constant current source, and
- 29 (2) the second constant current signal at said output of said
30 transducer connected in series with said activated
31 second constant current source.

1 5. A wireless communications transceiver system according to
2 claim 1 wherein each of said input section circuits of said variable gain mixers
3 further includes:

- 4 (a) a plurality of pairs of current sources, a first of each pair of
5 current sources supplying the first current signal and a second
6 of each pair of current sources supplying the second current
7 signal,
- 8 (b) a plurality of pairs of transistors, a first of each pair
9 individually connected in series with a first of each pair of
10 said current sources and a second of each pair connected in
11 series with a second of each pair of said current sources,
- 12 (c) a plurality of resistors each connected between a first of each
13 pair of said transistors and a second of each pair of said
14 switches, and
- 15 (d) means for selectively activating a pair of said current sources
16 to produce:
- 17 (1) the first constant current signal at the collector of said
18 transistor connected in series with a first of said pair of
19 activated current sources, and
- 20 (2) the second constant current signal at the collector of
21 said transistor connected in series with a second of said
22 pair of activated current sources.

1 6. A wireless communications transceiver system according to
2 claim 2 wherein each of said input section circuits of said variable gain mixers
3 includes:

- 4 (a) a plurality of pairs of current sources, a first of each pair of
5 current sources supplying the first current signal and a second
6 of each pair of current sources supplying the second current
7 signal,

- 8 (b) a plurality of pairs of transistors, a first of each pair
- 9 individually connected in series with a first of each pair of
- 10 said current sources and a second of each pair connected in
- 11 series with a second of each pair of said current sources,
- 12 (c) a plurality of resistors each connected between a first of each
- 13 pair of said transistors and a second of each pair of said
- 14 switches, and
- 15 (d) means for selectively activating a pair of said current sources
- 16 to produce:
- 17 (1) the first constant current signal at the collector of said
- 18 transistor connected in series with a first of said pair of
- 19 activated current sources, and
- 20 (2) the second constant current signal at the collector of
- 21 said transistor connected in series with a second of said
- 22 pair of activated current sources.

1 7. A wireless communications transceiver system according to

2 claim 1 wherein each of said input section circuits of said variable gain mixers

3 includes:

- 4 (a) a pair transducers connected in a differential configuration,
- 5 (b) a pair of constant current sources connected in series
- 6 individually with said pair of transducers,
- 7 (c) a plurality of series-connected resistor/FET branches
- 8 connected in parallel and between said pair of transducers;
- 9 and

10 (d) means for selectively activating one of said FET's in one of
11 said series-connected resistor/FET branches.

1 8. A wireless communications transceiver system according to
2 claim 2 wherein each of said input section circuits of said variable gain mixers
3 includes:

4 (a) a pair transducers connected in a differential configuration,

5 (b) a pair of constant current sources connected in series
6 individually with said pair of transducers,

7 (c) a plurality of series-connected resistor/FET branches
8 connected in parallel and between said pair of transducers;
9 and

10 (d) means for selectively activating one of said FET's in one of
11 said series-connected resistor/FET branches.

1 9. A wireless communications transceiver system according to
2 claim 1 wherein each of said input section circuits of said variable gain mixers
3 includes:

4 (a) a pair transducers connected in a differential configuration,

5 (b) a pair of constant current sources connected in series
6 individually with said pair of transducers,

7 (c) a plurality of series-connected inductor/FET branches
8 connected in parallel and between said pair of transducers;
9 and

10 (d) means for selectively activating one of said FET's in one of
11 said series-connected inductor/FET branches.

10. A wireless communications transceiver system according to claim 2 wherein each of said input section circuits of said variable gain mixers includes:

(a) a pair transducers connected in a differential configuration,

(b) a pair of constant current sources connected in series individually with said pair of transducers,

(c) a plurality of series-connected inductor/FET branches connected in parallel and between said pair of transducers; and

(d) means for selectively activating one of said FET's in one of said series-connected inductor/FET branches.

11. A variable gain mixer comprising:

means for supplying a first input signal;

means for supplying a second input signal;

an input section circuit responsive to the first input signal for translating the first input signal from a voltage signal to first and second constant current signals and having:

(a) a plurality of pairs of transducers with each pair of transducers connected in a differential configuration and:

(1) the outputs of a first of each pair of transducers connected together for supplying a first of the first and second constant current signals,

- 12 (2) the outputs of a second of each pair of transducers
13 connected together for supplying a second of the first
14 and second constant current signals,
- 15 (3) the inputs of a first of each pair of transducers
16 connected together for receiving the first input signal,
- 17 (4) the inputs of a second of each pair of transducers
18 connected together and for receiving the first input
19 signal,
- 20 (b) a plurality of resistors each connected between a first of each
21 pair of said transducers and a second of each pair of said
22 transducers, and
- 23 (c) a plurality of pairs of constant current sources, a first of each
24 pair connected in series with a first of each pair of said
25 transducers and a second of each pair connected in series with
26 a second of each pair of said transducers;
- 27 means for selectively activating a pair of said constant current
28 sources to produce:
- 29 (a) the first constant current signal at said output of said
30 transducer connected in series with said activated first
31 constant current source, and
- 32 (b) the second constant current signal at said output of said
33 transducer connected in series with said activated second
34 constant current source; and.
- 35 a mixer core circuit responsive to the first and second constant
36 current signals and the second input signal for developing a differential mixed

37 output signal that is the product of the constant current signals and the second
38 input signal.

1 12. A variable gain mixer according to claim 11 wherein said
2 mixer core circuit includes four transistors connected as a doubly-balanced
3 switching modulator.

1 13. A variable gain mixer comprising:

2 means for supplying a first input signal;

3 means for supplying a second input signal;

4 an input section circuit responsive to the first input signal for
5 translating the first input signal from a voltage signal to first and second constant
6 current signals and having:

7 (a) a plurality of pairs of current sources, a first of each pair of
8 said current sources supplying the first constant current signal
9 and a second of each pair of said current sources supplying
10 the second constant current signal,

11 (b) a plurality of pairs of transistors, a first of each pair of said
12 transistors individually connected in series with a first of each
13 pair of said current sources and a second of each pair of said
14 transistors connected in series with a second of each pair of
15 said current sources, and

16 (c) a plurality of resistors each connected between a first of each
17 pair of said transistors and a second of each pair of said
18 transistors;

19 means for selectively activating a pair of said current sources to
20 produce:

- 21 (a) the first constant current signal at the collector of said
- 22 transistor connected in series with a first of said pair of
- 23 activated current sources, and
- 24 (b) the second constant current signal at the collector of said
- 25 transistor connected in series with a second of said pair of
- 26 activated current sources; and.
- 27 a mixer core circuit responsive to the first and second constant
- 28 current signals and the second input signal and including four transistors
- 29 connected as a doubly-balanced switching modulator for developing a differential
- 30 mixed output signal that is the product of the current signals and the second input
- 31 signal.

1 14. A variable gain mixer comprising:

2 means for supplying a first input signal;

3 means for supplying a second input signal;

4 an input section circuit responsive to the first input signal for

5 translating the first input signal from a voltage signal to first and second constant

6 current signals and having:

- 7 (a) a pair transducers connected in a differential configuration,
- 8 (b) a pair of constant current sources connected in series
- 9 individually with said pair of transducers,
- 10 (c) a plurality of series-connected resistor/FET branches
- 11 connected in parallel and between said pair of transducers,
- 12 (d) means for selectively activating one of said FET's in one of
- 13 said series-connected resistor/FET branches to produce:

14 (1) the first constant current signal at a first output of said
15 first transducer, and

16 (2) the second constant current signal at a second output of
17 said second transducer; and.

18 a mixer core circuit responsive to the first and second constant
19 current signals and the second input signal for developing a differential mixed
20 output signal that is the product of the current signals and the second input signal.

1 15. A variable gain mixer according to claim 14 wherein said
2 mixer core circuit includes four transistors connected as a doubly-balanced
3 switching modulator.

1 16. A variable gain mixer comprising:

2 means for supplying a first input signal;

3 means for supplying a second input signal;

4 an input section circuit responsive to the first input signal for
5 translating the first input signal from a voltage signal to first and second constant
6 current signals and having:

7 (a) a pair transducers connected in a differential configuration,

8 (b) a pair of constant current sources connected in series
9 individually with said pair of transducers,

10 (c) a plurality of series-connected inductor/FET branches
11 connected in parallel and between said pair of transducers,

12 (d) means for selectively activating one of said FET's in one of
13 said series-connected inductor/FET branches to produce:

- 14 (1) the first constant current signal at a first output of said
15 first transducer, and
- 16 (2) the second constant current signal at a second output of
17 said second transducer; and.

18 a mixer core circuit responsive to the first and second constant
19 current signals and the second input signal for developing a differential mixed
20 output signal that is the product of the current signals and the second input signal.

1 17. A variable gain mixer according to claim 16 wherein said
2 mixer core circuit includes four transistors connected as a doubly-balanced
3 switching modulator

1 18. A variable gain mixer according to claim 13 wherein:

- 2 (a) said input section circuit further includes a first fixed DC bias
3 voltage source connected to said plurality of pairs of
4 transistors so that the currents at the outputs of said transistors
5 that are connected in series with the pair of activated constant
6 current sources are constant, and
- 7 (b) said mixer core circuit further includes a second fixed DC
8 bias voltage source connected to said four transistors so that
9 the differential mixed output signal is a constant current
10 signal.

1 19. A variable gain mixer according to claim 15 wherein:

- 2 (a) said transducers in said input section circuit are transistors,
- 3 (b) said input section circuit further includes a first fixed DC bias
4 voltage source connected to said transistors in said input
5 section circuit so that the currents at the outputs of said

transistors in said input section circuit that are connected in series with the pair of activated constant current sources are constant, and

(c) said mixer core circuit further includes a second fixed DC bias voltage source connected to said four transistors so that the differential mixed output signal is a constant current signal.

20. A variable gain mixer according to claim 17 wherein:

(a) said transducers in said input section circuit are transistors,

(b) said input section circuit further includes a first fixed DC bias voltage source connected to said transistors in said input section circuit so that the currents at the outputs of said transistors in said input section circuit that are connected in series with the pair of activated constant current sources are constant, and

(c) said mixer core circuit further includes a second fixed DC bias voltage source connected to said four transistors so that the differential mixed output signal is a constant current signal.